AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of predistorting a complex baseband signal *x* having an in-phase component I and a quadrature component Q, said method comprising the steps of:

sampling the complex baseband signal *x* to obtain k samples I_k of the in-phase component and k samples Q_k of the quadrature component;

for each of the obtained samples determining a respective distortion factor ~~$D_k = \{(\text{atanh}\ (Cx_k))/Cx_k\}e^{-jM\Phi_k}$, where $M\Phi_k = (B\pi x_k \tanh\ (Cx_k))/6$,~~ $\underline{D_k = \{(\text{atanh}\ (Cx_k))/Cx_k\}e^{-j\Phi_k}}$, $\underline{\text{where } \Phi_k = (\pi x_k \tanh\ (Cx_k))/6}$, x_k is the magnitude of the sample k, and C is a scaling factor;

multiplying each of the samples I_k of the in-phase component and each of the samples Q_k of the quadrature component by its respective distortion factor D_k to obtain a predistorted in-phase component sample and a predistorted quadrature component sample; and

combining the predistorted in-phase component samples and the predistorted quadrature component samples to provide a predistorted combined signal.

2. (Original) A method as claimed in claim 1, wherein for each of the k samples the respective distortion factor D_k is determined by:

determining the magnitude I_k of each of the k samples of the in-phase component and the magnitude Q_k of each of the k samples of the quadrature component;

for each of the k pairs of corresponding samples of the in-phase component and the quadrature component, determining a respective value of $x_k = (I_k^2 + Q_k^2)^{1/2}$; and

for each value of x_k, determining a value of tanh (Cx_k) and a value of (atanh $(Cx_k))/Cx_k$.

3. (Original) A method as claimed in claim 2, wherein for each value of x_k the value of tanh (Cx_k) is determined from a lookup table.

4. (Original) A method as claimed in claim 2, wherein for each value of x_k the value of atanh $(Cx_k)/Cx_k$ is determined from a lookup table.

5. (Original) A method as claimed in claim 2, wherein for each of the k pairs of corresponding samples the respective value of x_k is determined by:

detecting the maximum value of I_k and Q_k by determining the larger of I_k and Q_k;

detecting the minimum value of I_k and Q_k by determining the smaller of I_k and Q_k;

calculating a value y_k = ½ {(the detected minimum value) ÷ (the detected maximum value)}^{2}; and

calculating a value of $(I_k^2 + Q_k^2)^{1/2}$ as a function of y_k.

6. (Original) A method as claimed in claim 5, wherein the value of $(I_k^2 + Q_k^2)$ is calculated as (the detected maximum value) × $\{(1 + y_k)/2 + ½ (1 + y_k - y_k^2 + y_k^3 - y_k^4 + y_k^5 - y_k^6)\}$.

7. (Currently Amended) A method of generating an envelope

predistorted radio frequency signal, said method comprising the steps of:

providing an envelope modulated signal including a complex baseband signal x having an in-phase component I and a quadrature component Q;

sampling the complex baseband signal x to obtain k samples I_k of the in-phase component and k samples Q_k of the quadrature component;

for each of the obtained samples determining a respective distortion factor $\cancel{D_k = \{(\text{atanh}(Cx_k))/Cx_k\}e^{-jM\Phi_k}}$, ~~where~~ $\cancel{M\Phi_k = (B\pi x_k \tanh(Cx_k))/6}$, $\underline{D_k = \{(\text{atanh}(Cx_k))/Cx_k\}e^{-j\Phi_k}}$, <u>where</u> $\underline{\Phi_k = (\pi x_k \tanh(Cx_k))/6}$, x_k is the magnitude of the sample k, and C is a scaling factor;

multiplying each of the samples I_k of the in-phase component and each of the samples Q_k of the quadrature component by its respective distortion factor D_k to obtain a predistorted in-phase component sample and a predistorted quadrature component sample;

combining the predistorted in-phase component samples and the predistorted quadrature component samples to provide a predistorted combined signal;

up-converting the predistorted combined signal to provide a radio frequency signal; and

applying the radio frequency signal to a power amplifier have hyperbolic tangent distortion.

8. (Original) A method as claimed in claim 7, wherein for each of the k samples the respective distortion factor D_k is determined by:

determining the magnitude I_k of each of the k samples of the in-phase component

and the magnitude Q_k of each of the k samples of the quadrature component;

for each of the k pairs of corresponding samples of the in-phase component and the quadrature component, determining a respective value of $x_k = (I_k^2 + Q_k^2)^{½}$; and

for each value of x_k, determining a value of tanh (Cx_k) and a value of (atanh $(Cx_k))/Cx_k$.

9. (Original) A method as claimed in claim 8, wherein for each value of x_k the value of tanh (Cx_k) is determined from a lookup table.

10. (Original) A method as claimed in claim 8, wherein for each value of the x_k the value of atanh $(Cx_k)/ x_k$ is determined from a lookup table.

11. (Original) A method as claimed in claim 8, wherein for each of the k pairs of corresponding samples the respective value of x_k is determined by:

detecting the maximum value of I_k and Q_k by determining the larger of I_k and Q_k;

detecting the minimum value of I_k and Q_k by determining the smaller of I_k and Q_k;

calculating a value y_k = ½ {(the detected minimum value) ÷ (the detected maximum value)}^{2};

calculating a value of $(I_k^2 + Q_k^2)^{½}$ as a function of y_k.

12. (Original) A method as claimed in claim 11, wherein the value of $(I_k^2 + Q_k^2)$ is calculated as (the detected maximum value) × $\{(1 + y_k)/2 + ½ (1 + y_k - y_k^2 + y_k^3 - y_k^4 + y_k^5 - y_k^6)\}$.

13. (Original) A method as claimed in claim 7, further comprising the step of:

transmitting the radio frequency signal.

14. (Original) A method as claimed in claim 7, wherein the scaling factor C is based on a comparison of the envelope of the complex baseband signal x and the envelope of the radio frequency signal.

15. (Currently Amended) Apparatus for predistorting a complex baseband signal x having an in-phase component I and a quadrature component Q, said apparatus comprising:

a sampling circuit for sampling the complex baseband signal x to provide k samples I_k of the in-phase component and k samples Q_k of the quadrature component;

a distortion determining circuit for determining for each of the provided samples a respective distortion factor $\cancel{D_k = \{(\text{atanh}\ (Cx_k))/Cx_k\}e^{-jM\Phi_k}, \text{ where } M\Phi_k = (B\pi x_k \tanh\ (Cx_k))/6,}$ $\underline{D_k = \{(\text{atanh}\ (Cx_k))/Cx_k\}e^{-j\Phi_k}, \text{ where } \Phi_k = (\pi x_k \tanh\ (Cx_k))/6,}$ x_k is the magnitude of the sample k, and C is a scaling factor;

a first multiplier for multiplying each of the samples I_k of the in-phase component and each of the samples Q_k of the quadrature component by its respective distortion factor D_k to obtain a predistorted in-phase component sample and a predistorted quadrature component sample; and

a summing circuit for combining the predistorted in-phase component samples and the predistorted quadrature component samples to provide a predistorted combined signal.

16. (Original) Apparatus as claimed in claim 15, wherein said distortion

determining circuit comprises:

a first calculation circuit for determining for each of the k pairs of corresponding samples of the in-phase component and the quadrature component, a respective value of $x_k = (I_k^2 + Q_k^2)^{½}$; and

a second calculation circuit for determining for each value of x_k a value of tanh (Cx_k) and a value of (atanh $(Cx_k))/Cx_k$.

17. (Original) Apparatus as claimed in claim 16, wherein said second calculation circuit includes a plurality of lookup tables.

18. (Original) Apparatus as claimed in claim 16, wherein said first calculation circuit comprises:

first means for detecting the maximum value of I_k and Q_k by determining the larger of I_k and Q_k;

second means for detecting the minimum value of I_k and Q_k by determining the smaller of I_k and Q_k;

third means for calculating a value of y_k = ½ {(the detected minimum value) ÷ (the detected maximum value)}^{2}; and

fourth means for calculating a value if $(I_k^2 + Q_k^2)^{1/2}$ as a function of y_k.

19. (Original) Apparatus as claimed in claim 16, wherein said first calculating circuit calculates the value of $(I_k^2 + Q_k^2)^{1/2}$ as (the detected maximum value) × $\{(1 + y_k)/2 + ½\,(1 + y_k - y_k^2 + y_k^3 - y_k^4 + y_k^5 - y_k^6)\}$.

20. (Original) Apparatus as claimed in claim 15, wherein said sampling circuit, said distortion determining circuit, said first and second multipliers, and said summing circuit comprise a gate array.

21. (Original) Apparatus as claimed in claim 20, wherein said gate array is a field programmable gate array.

22. (Currently Amended) Apparatus for generating an envelope predistorted radio frequency signal, said apparatus comprising:

a source of an envelope modulated signal including a complex baseband signal *x* having an in-phase component I and a quadrature component Q;

a sampling circuit for sampling the baseband signal *x* to provide k samples I_k of the in-phase component and k samples Q_k of the quadrature component;

a distortion determining circuit for determining for each of the provided samples a respective distortion factor $\cancel{D_k = \{(\operatorname{atanh}(Cx_k))/Cx_k\}e^{-jM\Phi_k}}$~~, where~~ $\cancel{M\Phi_k = (B\pi x_k \tanh(Cx_k))/6}$~~,~~ $\underline{D_k = \{(\operatorname{atanh}(Cx_k))/Cx_k\}e^{-j\Phi_k}}$, where $\underline{\Phi_k = (\pi x_k \tanh(Cx_k))/6}$, x_k is the magnitude of the sample k, and C is a scaling factor;

a first multiplier for multiplying each of the samples I_k of the in-phase component and each of the samples Q_k of the quadrature component by its respective distortion factor D_k to obtain a predistorted in-phase component sample and a predistorted quadrature component sample;

a summing circuit for combining the predistorted in-phase component samples and the predistorted quadrature component samples to provide a predistorted combined signal;

an up-converter for up-converting the predistorted combined signal to provide a radio frequency signal; and

a power amplifier having hyperbolic tangent distortion for amplifying the radio frequency signal while canceling the predistortion therein.

23. (Original) Apparatus as claimed in claim 22, wherein said distortion determining circuit comprises:

a first calculation circuit for determining for each of the k pairs of corresponding samples of the in-phase component and the quadrature component, a respective value of $x_k = (I_k^2 + Q_k^2)^{½}$; and

a second calculation circuit for determining for each value of x_k a value of (tanh (Cx_k) and a value of atanh $(Cx_k))/Cx_k$.

24. (Original) Apparatus as claimed in claim 23, wherein said second calculation circuit includes a plurality of lookup table.

25. (Original) Apparatus as claimed in claim 23, wherein said first calculation circuit comprises:

first means for detecting the maximum value of I_k and Q_k by determining the

larger of I_k and Q_k;

second means for detecting the minimum value of I_k and Q_k by determining the smaller of I_k and Q_k;

third means for calculating a value of $y_k = ½ \{(\text{the detected minimum value}) = (\text{the detected maximum value})\}^2$; and

fourth means for calculating a value if $(I_k^2 + Q_k^2)^{1/2}$ as a function of y_k.

26. (Original) Apparatus as claimed in claim 23, wherein said first calculation circuit calculates the value of $(I_k^2 + Q_k^2)^{1/2}$ as (the detected maximum value) x $\{(1 + y_k)/2 + ½ (1 + y_k - y_k^2 + y_k^3 - y_k^4 + y_k^5 - y_k^6)\}$.

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27. (Original) Apparatus as claimed in claim 22, wherein said sampling circuit, said distortion determining circuit, said first and second multipliers, and said summing circuit comprise a gate array.

28. (Original) Apparatus as claimed in claim 27, wherein said gate array is a field programmable gate array.

29. (Original) Apparatus as claimed in claim 22, further comprising a circuit for providing the scaling factor C based on a comparison of the envelope of the complex baseband signal *x* and the envelope of the radio frequency signal.